

AMATEUR SATELLITE REPORT

AMSAT's Newsletter for the Amateur Space Program.



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Geo-Synchronous Satellite System In Early Planning Stages

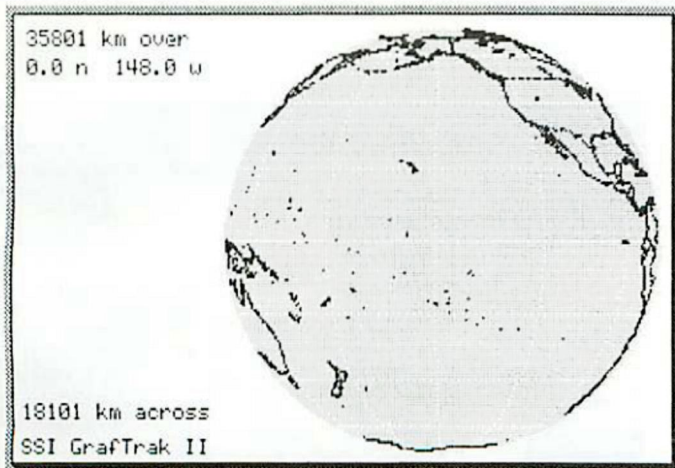
Progress is being made on several fronts towards a geo-synchronous Amateur Radio satellite capability according to AMSAT officials. The geo-synchronous satellites, often called Phase 4 satellites, have been the subject of keen interest recently as a result of several unrelated developments according to AMSAT President Vern Riportella, WA2LQQ.

These developments were said to be threefold. First was the recent National Aeronautics and Space Administration (NASA) announcement of its Advanced Communications Technology Satellite (ACTS) Program and the suggestion that it could conceivably include Amateur Radio interfaces. Second, it was recently learned by AMSAT Vice President for Engineering, Jan King, W3GEY, that there is a possibility of AMSAT flying its own transponder(s) aboard the ACTS spacecraft. Third, Arianespace has told AMSAT it is currently developing a so-called "piggy-back" pricing policy for small payloads on its Ariane 4 launcher. Thus, according to these officials, there are three avenues to a Phase 4 system currently under active study.

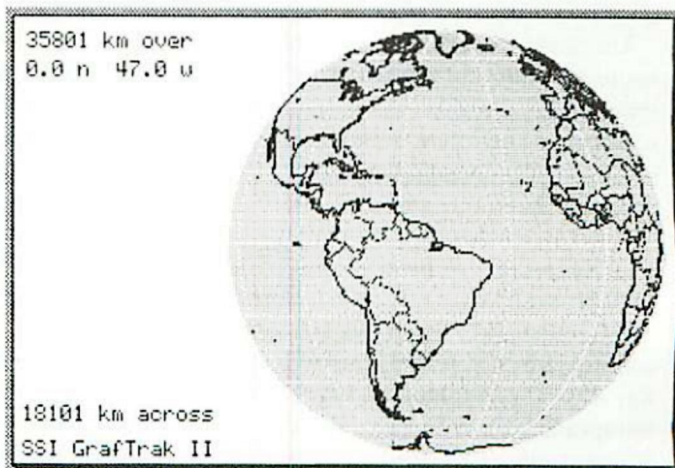
Several months ago in an article appearing in a popular trade publication, *Mobile Radio Technology*, the possibility of Amateur Radio participation in ACTS was aired. Many sharp-eyed AMSAT members read the article and found the

concept intriguing. Following up on the initial article, AMSAT President WA2LQQ contacted the NASA Lewis Research Center, the cognizant NASA center and obtained a series of documents detailing the technical and schedule aspects of ACTS. WA2LQQ sent copies of these documents to two dozen AMSAT technical leaders around the world for evaluation. The ad hoc AMSAT ACTS study group suggested ACTS was in fact out of reach of AMSAT. The group thought the 30/20 GHz uplink/downlink combination and the very high speed digital switching involved would tax our technical resources beyond the project's worth. While no one was willing to say "impossible", several pointed to other projects and suggested that all available resources would have to be devoted to ACTS at the expense of most other development activities. The cost in these terms, the group seemed to say, would be too high.

On the other hand, a number of the AMSAT ad hoc ACTS study group suggested that ACTS offered an excellent possibility for gateway access to a geo-synchronous spacecraft. With a few nodes around the country, the dream of a high-speed voice data or digital data network might easily be realized the group said. AMSAT is seeking individuals to work on a proposal to this effect and has dubbed this access to



Potential view from AMSTAR West, part of the P4A3 option.



Potential view from AMSTAR East, part of the P4A3 option.

the geo-synchronous capability the P4A1 option (Phase 4A, option 1).

Based on a suggestion by Butch Mason, W6KAG, to place AMSAT's own transponders aboard ACTS rather than rely on the SHF/EHF ACTS systems, W3GEY learned from senior ACTS Program officials that there is a slim possibility that this could be achieved. The NASA official did point out some major technical risk areas and pointed as well to a growing schedule risk. The launch is currently slated for fourth quarter, 1988, according to W3GEY.

Nevertheless, according to W3GEY, he heard nothing from NASA or the prime ACTS contractor, RCA Astro, that sounded like an absolute "No". Rather, reports W3GEY, he heard cautious encouragement. A preliminary concept would place a Mode L and a Mode S transponder aboard the ACTS payload. AMSAT's transponders would advantage themselves of conditioned power, station keeping and thermal control provided by the host. AMSAT would provide transponders, control and its own antennas. The antennas on ACTS appear unsuitable for any antennas AMSAT might use.

King emphasized to ASR that the key incentive for including AMSAT aboard ACTS, barring any fundamental technical constraints, was for NASA to perceive a positive technical innovation and/or public service aspect to any such proposition. Thus, AMSAT is now soliciting concrete suggestions as to how Amateurs might benefit society either directly through communications services or indirectly through technological innovation in connection with ACTS. King advises to be mindful of the nature of ACTS, that is, it is a communications technology experiment. An ACTS proposal team is to collect ideas and codify them in the form of a formal proposal to NASA.

According to preliminary concepts discussed by W3GEY and WA2LQQ, three types of service might be provided by the Mode L and S transponders. First would be a Mode L linear transponder similar to that on AO-10 and Phase 3C. Second would be a packet radio repeater or perhaps even packet switch. Finally, a third service might include a capability to both link selected terrestrial repeaters and group address repeaters for bulletins, training, educational materials and, of course, emergency communications on a hemispheric basis. Given the opportunity, AMSAT might also propose a more ambitious Amateur C-Band transponder as well.

The suggestion by Mason, W6KAG, was made based on his examination of the NASA ACTS documents and on his independent contacts in the space industry. It was W6KAG who established there might be payload accommodations sufficient for AMSAT's interests. The idea of placing an Amateur Radio transponder aboard a commercial or scientific geo-synchronous spacecraft has been discussed by AMSAT for nearly a decade and builds on the SYNCART (Synchronous Amateur Radio Transponder) concept of AMSAT Canada and Project OSCAR. More recently, a proposal was made by Cablesat General of Florida and its President, Ray Kassis, WA4OHK, to place a C-band Amateur Radio transponder aboard a proposed commercial spacecraft. The FCC recently eliminated Cablesat from competition for the orbital slot in which Cablesat was to place its satellite.

AMSAT will be working this possible Phase 4 option as

its P4A2 option. Concepts for use may be sent to AMSAT President WA2LQQ, P.O. Box 177, Warwick, NY 10990. Similarly, individuals interested in writing portions of AMSAT's proposal to NASA or in participating in a proposal team should contact WA2LQQ by mail at the same address.

A third avenue to a geo-synchronous system could be a two satellite system launched by an Ariane 4. Arianespace is known to be working on a low-cost, "piggy-back" system which seems ideally suited to carry an AMSAT payload to a geo-synchronous transfer ellipse. A two-satellite system with one placed over the equator at 47 degrees west and another over 148 degrees west would provide coverage for virtually all of North America to Western Europe and most of Africa on the eastern satellite (AMSTAR East) and most of North America to the Pacific basin including New Zealand, Eastern Australia and Japan on the western satellite (AMSTAR West). Further tradeoffs could be made in coverage and a terrestrial relay might be invoked to allow double-hop communications such that Australia, for instance, could work England. (See figures). AMSAT is working this option as P4A3. Engineering VP W3GEY and President WA2LQQ are planning to discuss these options at the Space Symposium and Annual General Meeting on November 9 in Vail, Colorado, and the following day with AMSAT's Directors. Comments and suggestions are solicited.

Within the last two years, discussions have addressed various Phase 4 ensembles including up to 6 satellites placed in pairs to provide globe-girdling coverage. A geo-synchronous drifter, which would move above the equator and make a complete orbit in about a month has also been discussed on the basis of a minimum "full-coverage" system which is time-shared. It would be continuously available to any non-polar QTH about 10 days per month.

However, neither AMSAT's officers nor its Directors are precisely certain what is in the greater interest of its members and the Amateur radio community for future projects. The view from AMSAT DL is that a follow-on to Phase 3C next summer should naturally be Phase 3D, a 1.2 scale version of Phase 3C with a super power Mode L transponder aboard (in the 200 to 300 watt class). Meanwhile, JAS-1 will be launched next summer as well. AMSAT UK and SA AMSAT are both interested in satellite projects with the latter now supporting the Mode S transponder project of Phase 3C.



Buck Henry, W3KH, (left) explains OSCAR antennas to a fellow amateur at an eastern Pennsylvania Hamfest in June.

Gargantuan 2 Meter Array Sprouts in Texas

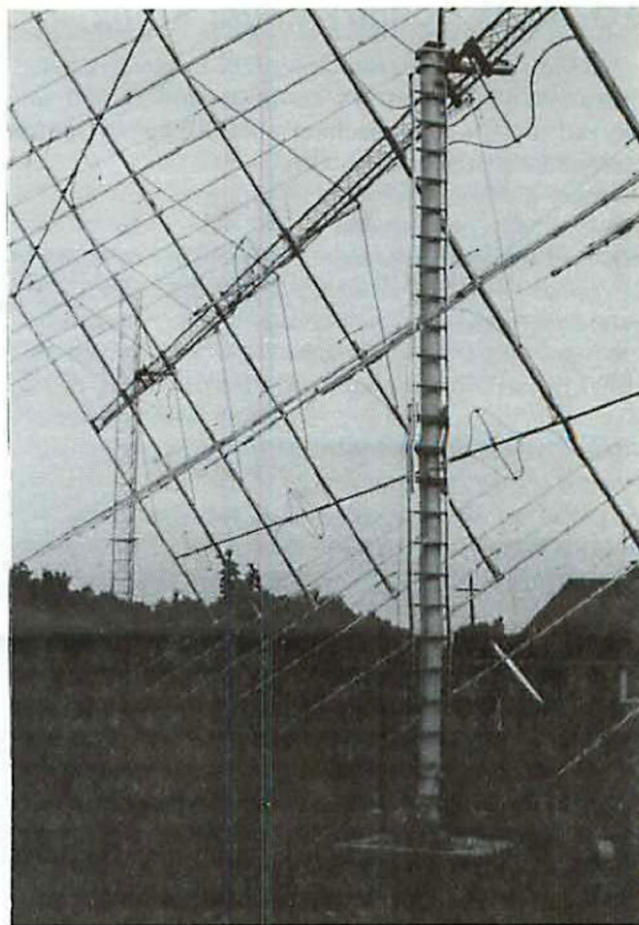
What must certainly be the largest 2 meter yagi array in the world has recently been pressed into service in Manvel, Texas by Dave Blaschke, W5UN. (See photos.) Dave writes:

"A new 2 meter EME array has been completed at W5UN which is capable of communicating with average sized stations equipped for 2 meter cw operation. The new array consists of 32 special KLM 17LBX antennas (31 foot boom) which were optimized for EME work. The "H" frame on which the antennas are mounted consists of 8 forty foot high crossarms mounted on a 97 foot long boom. Each crossarm holds four of the antennas. The entire array is supported by two 30 foot tall masts. One of the masts is fixed but rotatable. The other mast travels on a mobile platform (actually a 1947 Ford pickup truck chassis) around the fixed mast. The entire array occupies 115,000 cubic feet and requires approximately one acre of land to rotate 360 degrees.

"Performance tests tend to confirm the predicted 3.75 degree "E" plane beamwidth and the predicted 6.5 degree "H" plane beamwidth. Calculated gain exceeds 31 dBi. Return echoes from an unmodified IC-251 feeding a single yagi pointed at the moon are being heard at W5UN. Sun noise is measured at 13 to 14 dB above the noise and Cassiopeia A is 10 dB above the noise.

"It should be possible for stations with a single yagi to hear W5UN off the moon. Transmissions are made regularly on 144.008 MHz shortly after moonrise and when the moon is in a northerly declination. Stations feeding a single yagi with 160 watts or more should easily make contact with W5UN. W5UN is open for skeds. Write to W5UN or check into the EME net which meets every Saturday and Sunday at 1700 UTC on 14.345 MHz."

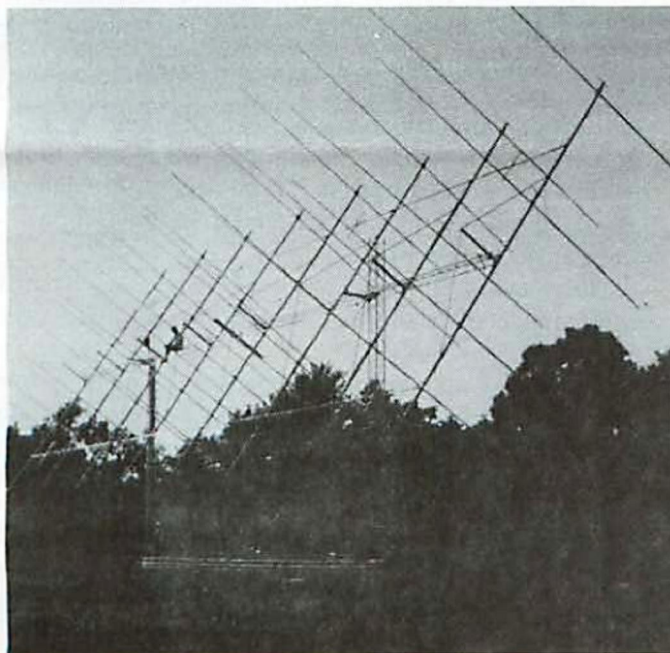
Write Dave Blaschke, W5UN, 9102 Kings Drive, Manvel, TX 77578.



AGM Banquet Prize List

At press time the following prizes were pledged to AMSAT for the Annual General Meeting Banquet in Vail Colorado November 9.

Prize	Donor
GRAND PRIZE ICOM IC-1271A all-mode 1.3 GHz Xcvt; see ASR #109	ICOM America
ARRL Model SP-144VDG in-line GaAsFET preamp	Advanced Receiver Research
Alinco model ALM-203T 2 meter FM HT	Alinco
Ken-Pro model KR-5600 dual axis rotor system	Encomm
Welz Model SP-450 UHF power meter	Encomm
AEA 2 meter Isopole antenna	AEA
Landwehr 2 meter mast mounted GaAsFET preamp	Henry Radio
Lunar model 2m4-40P 2 meter power amp with built in preamp	Lunar Electronics
Lunar model PAI 144D JFET 2 meter preamp	Lunar Electronics
KLM model 435-40CX 70cm crossed yagi	KLM
KLM model 145-22C 2 meter crossed yagi	KLM
Lunar model PAI 144B 2 meter preamp	Electronic Equipment Bank
Satellite Experimenter's Handbook	ARRL
OSCARLOCATOR	ARRL
ARRL Handbook	ARRL
ARRL Antenna Book	ARRL



Is this the world's largest 2 M yagi array? Comprising 32 long-boom yagis designed by K6MYC, the array is owned and operated by W5UN. (See story.)

AO-10 DX Country Count Rising

According to newly-appointed DX Bureau Manager Ed Steeb, WA2RDE, the DX country count heard and/or worked on AO-10 is reaching truly impressive numbers. Here is Ed's latest tally.

Z5	GW3,GW6,GW8	OA4	V3
A71	H44	OE1,OE3,OE4,OE5	VP2D (DOMINICA)
A92	HA,HG2,HG5	OE6,OE7,OE8,E9	VPSE (ANQUICCA)
BV	HB9	OH2,OH5,OH7	VP2V (British Virgin Islands)
BY1	HB0	OH0	VP5D (TURKS)
C30	HC1,HC2	OK1,OK3	VP8 (FALKLAND)
C6A	HC8	ON1,ON4,ON6,	VP9
CE	HI8	ON7	VS6
CE0A	HK4	OX3	VU
CO2	HL1,HL3	OY9	XE1,XE2
CN8	HZ1	OZ1,OZ5,OZ6	Y24
CT1	I0-I8,IT9	P29	YB
CX	IK0,IK1,IK6,IK8,IC8	PA2,PA3,PA8,PE1	YJ8
DB,DC,DD,DG,DF	IN2,IN3,IV3,IW1,	PJ2	YO2,YO3
DG,DJ,DK,DL	IW2,IW3,IW4,	PJ7	YU2,YU3,YU6
DP0	IW5,IW6	PY2,PY6	YV4,YV5
DU2,DU6	IS	PZ1	ZD8
EA1,EA3,EA5	J37	SK1,SK5,SK6,SK0	Z25
EA8	JA1-4,JA6-JA0,JC,	SM1-3,SM5,SM7,	ZF1
EI1,EI6,EI9	JE1-3,JE6-7,JF1-JF2	SM0	ZK1,ZK2,ZK2N,
F1,F2,F5,F6,F9,FC,	JF6-JF7,JG1-2,	SP9	ZK21,ZK2U,ZK2E
FD,FE	JH1-4,JH7-8,JK8	SU	ZL1-4
FT8	JD1 (OGASAWARA)	SV1,SV7	ZL (KERMADEC)
FC (NOW TK5)	JY1	T29	ZS2,ZS5,ZS6
FS7	K,W,N,A	TF	ZS3,ZR1,ZR2, ZR3,
FK2,FK8	KG4	TI2	ZR6
FM5,FM7	KH2,KG6	TR8	3A
FO0	KH6,WH6	TU2	3D2
FO8	KL5,KL7	TZ6	4UITU (GENEVA)
FR7 (REUNION)	DP2,KV4	UA1,UA3,UA4	4UITU (U.N.)
FY7	KP5 (DESECHIO)	UKS	4X4,4Z4
G1,G3,G4,G5,G6,	LA1,LA3,LA5,LA6,	UBS	5B4
G8,G0	LA8,LA9	UC2	5N8
GD4	LU1,LU2,LU4,LU5,	UL7	6W
G11,G14,G16,G18	LU7,LU8,LU9	UM8	7P8
GJ6,GJ8	LX1	VE1-8, VO1,VY	8Q7
GM1,GM3,GM4,	LZ,	VK1-5,VK7,VK8	9H1
GM6,GM8	KP4	VK9 (WILLIS)	9M2
GU6	OA4	VK0 (HEARD)	9Y4

Mode L Experiments To Support Phase 4 Concepts

AMSAT President Vern "Rip" Riportella has announced a new series of experiments on AO-10 Mode L which promise to illustrate the functional capability of future satellite systems for bulletin transmission via satellite. As a bonus, the experiments may yield meaningful engineering data on the merits of ACSSB techniques compared to FM.

There are several facets to the experiment to be performed over the next year or so on AO-10, Mode L. As explained to ASR recently, the unique window of opportunity for these experiments derives from the partial malfunction of the Mode L transponder.

As reported earlier in ASR, AMSAT engineers have determined that the defect reducing the usefulness of AO-10 Mode L is attributable to the failure of a bias regulator transistor in the Mode L power amplifier. The amplifier is operating in a non-linear regime and with light loading provides very little downlink for a given uplink. However, there is some self-biasing of the amplifier stage. Consequently, with a number of strong signals in the receiver's passband, the

transponder exhibits a somewhat more linear response and makes getting through the transponder easier for low power stations. The increased performance is seen clearly when the RTTY telemetry replaces the PSK telemetry on 436.040 MHz at quarter hour intervals for 5 minute episodes. The downlink signals normally come up a dB or so when the RTTY is on.

The result is that it takes about 10 dB more uplink power than expected to have a reasonable downlink signal-to-noise ratio. Whereas Mode L was designed to provide about a 10 dB S/N ratio with an uplink in the 2 kW EIRPc region it presently takes about 20 kW EIRPc for the same S/N.

WA2LQQ described the window of opportunity this way.

"Originally we were delighted to have Mode L as a safety valve for Mode B overflow. But we recognized the inertia represented by existing equipment, station capabilities and operating as well as technical practice. We felt that when anticipated heavy Mode B traffic (as we now occasionally experience on weekends) made Mode B less desirable, we would increase the ratio of Mode L to Mode B operating time gradually to provide added incentive for Mode L user migration.

"However, we now have a real counter-force to Mode L migration incentives which makes it less viable. Currently it just takes too much power for most to move to Mode L. The result is the desired Mode L migration will probably occur at a higher Mode B 'annoyance threshold' than earlier anticipated and most likely the flow will not reach full strength until Phase 3C is well-established.

"Consequently the overall philosophy of Mode L use has been perturbed. Instead of scores of low power users distributed regularly across the vast Mode L expanse (800 kHz), we have but a handful of higher-power users rattling around in this huge passband much as a string quartet in a vacant Wembley Stadium; barely able to find each other if they didn't know where to meet! This suggests to me an opportunity for meaningful experiments which can in some measure compensate for the otherwise diminished usefulness of Mode L and, indeed, set the stage for the flawless performance of Mode L on Phase 3C next summer.

"Previously we would have been constrained by available downlink power and the legitimate desire to share power more or less equally among all users present. But it's evident by usage patterns that most cannot field sufficient power to result in usable downlinks. So why not take an alternative approach?

"Since available downlink power is no longer a major constraint, let us do some experiments to see what a modest Mode L Receive Only (RO) station might hear from a very strong Mode L uplink. Then we might try linking this downlink into terrestrial repeater networks as a demonstration of possible future capabilities of Phase 4 Mode L and Mode S. Concurrent Mode L users will benefit (up to a point we'll have to determine) from the linearization of the Mode L amplifier resulting from the strong bulletin station. "Since spectrum is no longer a major constraint, we might try FM bulletins as well as SSB. How well will ACSSB compare to FM both objectively and subjectively? Can similar S/N be realized? These are the types of answers and results I hope we can obtain from the impending series of experiments on Mode L.

"Finally, I sense that given the balance of negatives impeding migration from Mode B to Mode L, it may take the addition of a notable positive attraction to catalyze upward mode mobility. Perhaps the planned noise-free, spin modulation-free bulletins and other "premium communication services" planned for Mode L will add the positive note required to offset the balance of negatives between B and L."

Initial Mode L experiments from WA2LQQ are planned for late October with late November targeted for regular Mode L bulletin service. Bulletins on Mode L will be scheduled as often as conditions and convenient times will allow. The ZRO Memorial Technical Achievement Award will open its Mode L series of tests in November as well.

The new experimental Mode L station at WA2LQQ has been under development since Spring. John Beanland, G3BVU, proprietor of Spectrum International in Concord, Massachusetts donated a Microwave Modules 1269 MHz transmit converter for the effort. Chip Angle, N6CA, of Angle Linear volunteered to build a 2C39 amplifier in support of Mode L experiments. Dan Burge, WA7BJU of Continental Satellite was kind enough to develop special packages and price breakouts in response to a perceived need for more Mode L equipment support. Continental Satellite builds dish antennas for the TVRO and cable business. Mike Staal, K6MYC, formerly of KLM and now a consultant and free-lance designer designed a new type of feed for the Mode L dish. Jim Eagleson, WB6JNN of Project OSCAR is building a Level 1 ACSSB unit for the tests. Jim's participation is a continuation of the on-going Project Companion which has the objective of bringing ACSSB techniques to the Amateur Radio bands.

The experimental high-power Mode L station at WA2LQQ is almost ready to air. The WA2LQQ Mode L station will have sufficient reserve to counter marginal satellite pointing angles. At full bore the 18 foot dish and 2C39 amplifier could provide upwards of 350 kW EIRPc if needed. Experiments will indicate what levels are required for optimum use by all and what, if any, effects these operations will have on battery charge/discharge rates.

Meanwhile "Project Linkup" has been initiated to concentrate efforts for evaluating direct satellite to repeater linking. Bulletins transmitted over AO-10 Mode L will be interconnected to selected repeaters to determine the efficacy of this mode. The experimental FM transmissions will carry various types of Amateur Radio bulletin information. AMSAT bulletins as well as occasional training and educational material may be provided depending on initial results. The ARRL has expressed a preliminary interest in these experiments and may participate with bulletins of general interest.

Plans for Project Linkup call for perhaps a dozen special portable Mode L RO stations to be placed on short-term loan to repeater organizations and clubs for hamfests and conventions. The portable LRO stations would comprise a 70 cm crossed yagi with about 10 or 11 dBi gain. The yagi would break down to two easily assembled half booms each about 36" long. A 70 cm GaAsFET preamp with a noise figure in the vicinity of 0.7 to 0.8 dB and a gain of 17 to 20 dB would be included. A receive converter which would convert 436 MHz to the 2 meter band would also be part of the kit. The choice of the 2 meter i-f is a touchy one. Since 2 meter FM HTs are proliferate, it's an easy path to recover baseband audio to pump into the repeater. But what if the repeater has a 2 meter output? Will it interfere with the 2 meter output of the receive converter? Experiment may be necessary here as well.

Jay Rusgrove, W1VD, of Advanced Receiver Research as well as John Beanland, G3BVU, of Spectrum International have expressed an interest in Project Uplink and may be invited to supply equipment for the experimental kits. Meanwhile, AMSAT is soliciting help from individuals who, on the one hand, would like to help assemble the kits, and on the other hand, would like to help Project Uplink "connect" with the repeater community for these experiments. In both cases, interested individuals should contact AMSAT President WA2LQQ at P.O. Box 177, Warwick, NY 10990. Mark your correspondence attention Project Uplink.



Sarge (left) and Syl display their Hams-In-Space T-Shirts. These folks are Martha Saragovitz' parents.

WA4SIR Selected To Fly Shuttle Next March

Dr. Ron Parise, WA4SIR, has been selected by NASA to fly the ASTRO 1 space shuttle mission in March, 1986. Ron is an AMSAT member and was formerly AMSAT's UoSAT Science Advisor.

Ron was notified of his selection as a Payload Specialist on 11 June 84 after having applied in September 1983. (See ASR #81, July 2, 1984). Formerly an employee of the Systems Sciences Division of Computer Sciences Corporation, he is an astronomer with a PhD from the University of Florida.

The selection for ASTRO 1 means a nominal liftoff aboard mission 61E of 06 Mar. 86, according to Ron. Dr. Parise designed and will operate some of the unique astronomical instruments aboard ASTRO 1. The Ritchie-Chretien ultra-violet telescope may glimpse Halley's comet.

A proposal to place a packet radio Terminal Node Controller (TNC) aboard the flight is being composed by a group

in the Washington, D.C. area as reported by Dr. Tom Clark, W3IWI. Tom says that some hardware is now coming together and that the plan calls for a special version of the Tucson Area Packet Radio (TAPR) TNC-2 to be aboard. A team of about a dozen individuals is supporting the proposal which all admit has a very short "fuse".

The flight of WA4SIR probably will mark the fourth Ham-In-Space Mission aboard the shuttle. W5LFL and W0ORE have already flown their pathfinder missions. The German and Dutch astronauts aboard Spacelab D1 are due to fly their mission later this month. WA4SIR will fly next March while Owen Garriott, W5LFL, may get his second Ham-In-Space mission next autumn. Planners at the Johnson Space Center are already talking about novel approaches to the challenge of a further follow-on.

Meanwhile Dr. Parise can expect at least one further flight aboard either ASTRO 2 or 3.

Short Bursts

- AMSAT congratulates Harold Price, NK6K, on another fine article on PACSAT, this one appearing in the September edition of Personal Communications.
- AMSAT congratulates new Assistant Area Coordinators Edward Stearns, AA7A, AAC for Arizona and David Guimont, WB6LLO, AAC for the San Diego area of California.
- AMSAT Congratulates Ed Henderson, N8BOD, on his new AMSAT advertisement artwork. The new ads will be appearing in several Amateur Radio magazines and newsletters soon.
- AMSAT congratulates Assistant Vice President Mike Crisler, N4IFD, for a fine job leading the AMSAT's presence at the ARRL National Convention in Louisville. Supporting were W8PGP and W3XO et al.
- AMSAT congratulates Bill Tynan, W3XO, AMSAT Vice President for Manned Space Flight, for his having accepted the return of AMSAT's flag from astronaut Tony England, W0ORE, at the ARRL National Convention. The flag, fabricated by Phyllis Zwirko, XYL of K1HTV, flew with the ARRL flag aboard shuttle 51F and Tony, W0ORE, during the second Ham-In-Space mission recently.
- AMSAT congratulates Dick Burgraff, W8PGP and Bob Rogers, W8JLE on their fine job in manning the AMSAT booth at the Cincinnati Hamfest September 15.
- AMSAT congratulates Alan Clark, WD5IKD, on his fine job of representing AMSAT at the recent Mississippi Gulf Coast Hamfest, Oct. 5-6 in Biloxi, MS.
- AMSAT congratulates the University of Surrey on the occasion of the fourth anniversary of the launch of UoSAT-1 aka UO-9, October 7!
- Publisher Doug Bornstein, WA2JTC, reports advertisers are showing renewed interest in AMSAT's *Satellite Journal* magazine. Issue #5 is in the mail. Issue #6 is targeted for early November.
- Time is running out if you have not made reservations at the Westin Hotel in Vail and you plan to attend the Space Symposium and Annual Meeting November 9. Check out the fabulous prize list elsewhere in this issue. Don't delay further if you expect to get the discounted room rates. Call ASAP 303-476-7111 to make your reservations.

- New Video Tape Librarian is Tom Larson, N1CHM. He will send you a copy of the library list and operating procedures in return for a SASE. Mail to Tom Larson, N1CHM, AMSAT Video Tape Library, 85 Main Street, Dover, MA 02030. Tom and Roger Johnson, WB0GAI will be taping the Space Symposium at Vail and the proceedings will be in the library soon thereafter.

- Jeff Kelly, KT2K, has edited the W0ORE audio tapes down to the bare minimum eliminating the dead-air time. AMSAT plans to transmit these on the air in the near future. Watch for announcements regarding time and frequency. A special tape of just the SSTV audio is also available.

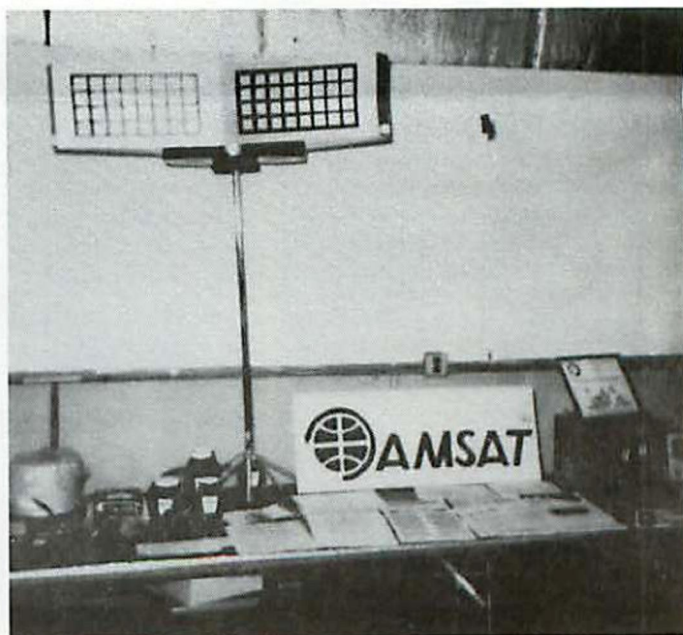
- The Second San Francisco OSCAR Users Meeting will be held October 20 9:30 AM to 5 PM at the Villa Hotel in San Mateo, California. Special guest speakers include W6SP, K6MYC, WB6MLC, K6FO and WB6GFJ. Contact WB6GFJ for details. Topics will include AMSAT policy, satellite antennas, packet radio on OSCAR, getting started on OSCAR and San Francisco Activity review.

- The new AMSAT-ARRL-NASA T-shirts are available at AMSAT HQ for a \$15 donation. These lovely light blue quality shirts are emblazoned with a striking illustration of space shuttle mission 51F, the mission of W0ORE. Featured is SA-REX, the Shuttle Amateur Radio Experiment and the AMSAT, ARRL and NASA logos. Available in s, m, l and xl. Please specify. AMSAT, 850 Sligo Ave., Silver Spring, MD 20910. 301-589-6062.

- Bob Diersing, N5AHD, has developed a new program for decoding UoSAT telemetry. It will be available through the AMSAT Software Exchange soon.

- The Young Astronauts Program (YAP) is seeking hams around the country who can perform live space communications demonstrations for youngsters in the 6 to 14 age bracket. Demonstrations of OSCAR communications and EME QSOs are particularly relevant. Contact ARRL Washington Office, Bill Lazzaro, N2CF at 202-429-9748.

- Articles are solicited for *AMSAT Satellite Journal*. If you have a topic you believe warrants an article, why not write up a synopsis or abstract and mail it off for possible use.



Dick Burgraff, W8PGD and Joe Berman, N8ATB manned this AMSAT booth at the Columbus, Ohio Hamfest on June 2.

Mail to ASJ Editor Harold Winard, KB2M, P.O. Box 575, Wharton, NJ 07885.

- The next ZRO Memorial Test session will be on Sunday, October 20 at 0315 UTC. Downlink frequency will be 145.840 MHz.
- A possible AO-10 operating schedule change may be implemented in conjunction with an anticipated attitude change on or about 22 October. Watch the beacon frequencies, 145.810 and 436.040 MHz, for details and schedules.
- AMSAT has obtained a collection of rare OSCAR memorabilia including some classic OSCAR posters. These early OSCAR years posters are available in limited quantities for a mere \$5.00 donation and a minimum 30 inch mailing tube. Send the tube and your donation to AMSAT HQ for your classic OSCAR poster.
- The long-heralded AMSAT Phase 3 Operations Manual is in the final editing stages according to K8OCL and W6SP. Printing is anticipated by year's end. Project OSCAR is considering undertaking the printing project in a manner similar to their production of the Project OSCAR orbit prediction books.
- AMSAT is looking for ideas on ways to celebrate the 25th Anniversary of OSCAR 1's launch next year. A special series of commemorative events is being planned for next year but we need your suggestions too. A special 25th anniversary yearbook with lots of features on past and current OSCAR operations and operators is planned. Want to be a part? Let us know soon!

ESA Launches Halley Probe

The European Space Agency launched its Giotto spacecraft, Europe's first interplanetary probe, on July 2. It is to sail to a 1986 rendezvous with the famed Halley's Comet. The launch from Kourou Space Center on the north coast of South America, scheduled for 8:13 a.m. (7:13 a.m. EDT,) was delayed by nine minutes, but appeared to go off without a hitch.

Fifteen minutes after the launching, Giotto, separating from Ariane, was thrust into what is called a parking orbit, ESA said. The satellite's onboard motor was due to kick it into space on its fourth orbit of the Earth.

If all goes well, Giotto, being carried into space by ESA's Ariane rocket, is to approach within 310 miles of the dust-shrouded nucleus of the comet and photograph, measure and gather data on its components.

But despite special shielding, scientists say the dust around the comet may destroy Giotto within hours of the scheduled March 13, 1986, rendezvous.

ESA has called the expedition one of the few "missions left in the solar system where major surprises can still be expected."

The launch is the 14th for Ariane, whose 11 previous successes have made it competitive with the U.S. space shuttle for satellite launchings.

The spacecraft is named after the 14th-century Florentine painter Giotto di Bondone, who saw Halley's comet in 1301 and portrayed it as the Star of Bethlehem in a painting of the birth of Jesus Christ.

The comet was named after British astronomer Edmond Halley, who studied it in 1607 and predicted its 76-year cy-

cle. It was observed in Rome in 87 B.C., when Julius Caesar was 14, and astronomers say it probably is the same comet recorded by Chinese astronomers in 1057 B.C.

ESA has spent about the equivalent of \$106 million on Giotto including development of the spacecraft and the cost of the Ariane launcher. Federal budget cuts kept NASA from mounting a probe of Halley, the most famous of the comets. More than 200 scientists from 87 institutions in all the ESA nations are taking part in the project.

The Giotto craft will carry 10 separate experiment packages to study the comet. Cameras will take color photographs of features on the nucleus; sensors aim to capture dust finer than smoke particles; and six different experiments will study the interaction of the solar wind and the comet's atmosphere.

Other instruments will identify the chemical and isotope composition of the comet's halo. European scientists expect to be able to identify the molecules from which the nucleus is made.

ESA is particularly excited about the mobile multicolor camera on board, computer controlled to lock on to the nucleus as it approaches and follow it through 180 degrees, looking back after flyby.

"Beside the fascination of seeing the nucleus of a comet for the first time," said an ESA spokesman, the pictures should show if just a few "hot spots" on its surface create the dust and gas jets seen in the coma or aura.

Decoding OSCAR 10 Telemetry

by Julian Macassey, N6ARE

Two stations in the Los Angeles area are using the G3RUH telemetry decoder in novel ways. One station is taking the "Low Tech" approach and another station is taking the "High Tech" approach.

Butch Mason W6KAG, is decoding his telemetry with the G3RUH decoder and feeding it into his Kaypro computer. Butch has written a d-Base II routine to align the telemetry data and store it so he can compare telemetry parameters over time.

Chris Wachs, WA2KDL, has taken the "Low Tech" route in the best amateur tradition. Lacking a computer, he records the raw PSK feed direct from his receiver into a cassette recorder. In parallel he runs the decoder watching the carrier lock and clock lock signals to ensure he has the receiver properly tuned. Chris then feeds the audio from the tape into his dumb terminal to read the M and Y blocks.

For better utilization, Chris feeds the audio into his dumb terminal then into his TAPR TNC. His signal is copied by Julian Macassey, N6ARE who formats the ASCII text from the M and Y blocks using Wordstar.

Julian loads the edited ASCII onto the local packet bulletin board for the use of the local AMSAT members.

Oscar-10 Decoder kits are available from RadioKit Box 411, Greenville, New Hampshire 03048. A PC Board is available from AMSAT UK, London E12 5EQ for twenty pounds. Construction and use instructions for the decoder are in *Wireless World* October and November 1984 and *Ham Radio Magazine* April 1985.

Orbit Predictions

By KA9Q

OSCAR-9		Satellite		RS-5		Satellite		NOAA-8		Satellite		NOAA-9	
Catalog number	12888	Catalog number	12999	Catalog number	13923	Catalog number	15427	Catalog number	13923	Catalog number	15427	Catalog number	15427
Epoch time:	85276.41448399	Epoch time:	85272.36987969	Epoch time:	85257.38501718	Epoch time:	85262.22641727	Epoch time:	85257.38501718	Epoch time:	85262.22641727	Epoch time:	85262.22641727
Thu Oct 3 09:56:51.416 1985 UTC		Sun Sep 29 08:52:37.605 1985 UTC		Sat Sep 14 09:14:25.484 1985 UTC		Thu Sep 19 05:26:02.452 1985 UTC		Sat Sep 14 09:14:25.484 1985 UTC		Thu Sep 19 05:26:02.452 1985 UTC		Thu Sep 19 05:26:02.452 1985 UTC	
Element set:	799	Element set:	267	Element set:	117	Element set:	37	Element set:	117	Element set:	37	Element set:	37
Inclination:	97.6414 deg	Inclination:	82.9525 deg	Inclination:	98.6591 deg	Inclination:	98.9553 deg	Inclination:	98.6591 deg	Inclination:	98.9553 deg	Inclination:	98.9553 deg
RA of node:	266.6496 deg	RA of node:	248.3138 deg	RA of node:	287.6163 deg	RA of node:	215.7717 deg	RA of node:	287.6163 deg	RA of node:	215.7717 deg	RA of node:	215.7717 deg
Eccentricity:	0.0001081	Eccentricity:	0.0007975	Eccentricity:	0.0016697	Eccentricity:	0.0014817	Eccentricity:	0.0016697	Eccentricity:	0.0014817	Eccentricity:	0.0014817
Arg of perigee:	212.6663 deg	Arg of perigee:	209.7411 deg	Arg of perigee:	175.4269 deg	Arg of perigee:	194.3161 deg	Arg of perigee:	175.4269 deg	Arg of perigee:	194.3161 deg	Arg of perigee:	194.3161 deg
Mean anomaly:	147.4512 deg	Mean anomaly:	150.3195 deg	Mean anomaly:	184.7063 deg	Mean anomaly:	165.7587 deg	Mean anomaly:	184.7063 deg	Mean anomaly:	165.7587 deg	Mean anomaly:	165.7587 deg
Mean motion:	15.27626729 rev/day	Mean motion:	12.05049503 rev/day	Mean motion:	14.22470367 rev/day	Mean motion:	14.11381042 rev/day	Mean motion:	14.22470367 rev/day	Mean motion:	14.11381042 rev/day	Mean motion:	14.11381042 rev/day
Decay rate:	1.126e-05 rev/day²	Decay rate:	4e-08 rev/day²	Decay rate:	6.1e-07 rev/day²	Decay rate:	1.2e-06 rev/day²	Decay rate:	6.1e-07 rev/day²	Decay rate:	1.2e-06 rev/day²	Decay rate:	1.2e-06 rev/day²
Epoch rev:	22175	Epoch rev:	16645	Epoch rev:	12804	Epoch rev:	3960	Epoch rev:	12804	Epoch rev:	3960	Epoch rev:	3960
Semi major axis	6858.011 km	Semi major axis	8033.857 km	Semi major axis	7192.300 km	Semi major axis	7229.968 km	Semi major axis	7192.300 km	Semi major axis	7229.968 km	Semi major axis	7229.968 km
Anom period:	94.263865 min	Anom period:	119.497166 min	Anom period:	101.232337 min	Anom period:	102.027727 min	Anom period:	101.232337 min	Anom period:	102.027727 min	Anom period:	102.027727 min
Apogee:	486.727 km	Apogee:	1667.303 km	Apogee:	826.297 km	Apogee:	863.812 km	Apogee:	826.297 km	Apogee:	863.812 km	Apogee:	863.812 km
Perigee:	485.245 km	Perigee:	1654.489 km	Perigee:	802.279 km	Perigee:	842.386 km	Perigee:	802.279 km	Perigee:	842.386 km	Perigee:	842.386 km
Ref perigee:	2832.38767203	Ref perigee:	2828.33522932	Ref perigee:	2813.41924826	Ref perigee:	2818.19379385	Ref perigee:	2813.41924826	Ref perigee:	2818.19379385	Ref perigee:	2818.19379385
Thu Oct 3 09:18:14.863 1985 UTC		Sun Sep 29 08:02:43.812 1985 UTC		Sat Sep 14 10:03:43.49 1985 UTC		Thu Sep 19 04:39:03.788 1985 UTC		Sat Sep 14 10:03:43.49 1985 UTC		Thu Sep 19 04:39:03.788 1985 UTC		Thu Sep 19 04:39:03.788 1985 UTC	
Beacon:	145.8250 MHz			Beacon:	137.5000 MHz	Beacon:	137.5000 MHz	Beacon:	137.5000 MHz	Beacon:	137.5000 MHz	Beacon:	137.5000 MHz

Satellite		OSCAR-10		Satellite		RS-7	
Catalog number	14129	Catalog number	13001	Catalog number	13001	Catalog number	13001
Epoch time:	85275.85372603	Epoch time:	85274.01345740	Epoch time:	85274.01345740	Epoch time:	85274.01345740
Wed Oct 2 20:29:21.928 1985 UTC		Tue Oct 1 00:19:22.719 1985 UTC		Tue Oct 1 00:19:22.719 1985 UTC		Tue Oct 1 00:19:22.719 1985 UTC	
Element set:	205	Element set:	218	Element set:	218	Element set:	218
Inclination:	26.2273 deg	Inclination:	82.9550 deg	Inclination:	82.9550 deg	Inclination:	82.9550 deg
RA of node:	116.0561 deg	RA of node:	242.0455 deg	RA of node:	242.0455 deg	RA of node:	242.0455 deg
Eccentricity:	0.5965246	Eccentricity:	0.0022494	Eccentricity:	0.0022494	Eccentricity:	0.0022494
Arg of perigee:	50.5133 deg	Arg of perigee:	134.9399 deg	Arg of perigee:	134.9399 deg	Arg of perigee:	134.9399 deg
Mean anomaly:	348.9904 deg	Mean anomaly:	225.3514 deg	Mean anomaly:	225.3514 deg	Mean anomaly:	225.3514 deg
Mean motion:	2.05856198 rev/day	Mean motion:	12.08694756 rev/day	Mean motion:	12.08694756 rev/day	Mean motion:	12.08694756 rev/day
Decay rate:	-4.8e-07 rev/day²	Decay rate:	3e-08 rev/day²	Decay rate:	3e-08 rev/day²	Decay rate:	3e-08 rev/day²
Epoch rev:	1735	Epoch rev:	16715	Epoch rev:	16715	Epoch rev:	16715
Semi major axis	26105.451 km	Semi major axis	8017.686 km	Semi major axis	8017.686 km	Semi major axis	8017.686 km
Anom period:	699.517437 min	Anom period:	119.136779 min	Anom period:	119.136779 min	Anom period:	119.136779 min
Apogee:	35302.337 km	Apogee:	1668.130 km	Apogee:	1668.130 km	Apogee:	1668.130 km
Perigee:	4157.250 km	Perigee:	1632.060 km	Perigee:	1632.060 km	Perigee:	1632.060 km
Ref perigee:	2831.86858214	Ref perigee:	2830.04440185	Ref perigee:	2830.04440185	Ref perigee:	2830.04440185
Wed Oct 2 20:50:45.496 1985 UTC		Tue Oct 1 01:03:56.319 1985 UTC		Tue Oct 1 01:03:56.319 1985 UTC		Tue Oct 1 01:03:56.319 1985 UTC	
Translate freq	581.0047 MHz						
Invert:	1						
Beacon:	145.8100 MHz						

Satellite		OSCAR-11		Satellite		RS-8	
Catalog number	14781	Catalog number	14781	Catalog number	12998	Catalog number	12998
Epoch time:	85275.71454271	Epoch time:	85275.71454271	Epoch time:	85274.03973838	Epoch time:	85274.03973838
Wed Oct 2 17:08:56.490 1985 UTC		Wed Oct 2 17:08:56.490 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC	
Element set:	89	Element set:	89	Element set:	341	Element set:	341
Inclination:	98.1810 deg	Inclination:	98.1810 deg	Inclination:	82.9531 deg	Inclination:	82.9531 deg
RA of node:	340.8135 deg	RA of node:	340.8135 deg	RA of node:	250.3508 deg	RA of node:	250.3508 deg
Eccentricity:	0.0012070	Eccentricity:	0.0012070	Eccentricity:	0.0017936	Eccentricity:	0.0017936
Arg of perigee:	250.2792 deg	Arg of perigee:	250.2792 deg	Arg of perigee:	273.3515 deg	Arg of perigee:	273.3515 deg
Mean anomaly:	109.7087 deg	Mean anomaly:	109.7087 deg	Mean anomaly:	86.5464 deg	Mean anomaly:	86.5464 deg
Mean motion:	14.61994195 rev/day	Mean motion:	14.61994195 rev/day	Mean motion:	12.02955854 rev/day	Mean motion:	12.02955854 rev/day
Decay rate:	8e-07 rev/day²	Decay rate:	8e-07 rev/day²	Decay rate:	4e-08 rev/day²	Decay rate:	4e-08 rev/day²
Epoch rev:	8474	Epoch rev:	8474	Epoch rev:	16636	Epoch rev:	16636
Semi major axis	7061.956 km	Semi major axis	7061.956 km	Semi major axis	8043.182 km	Semi major axis	8043.182 km
Anom period:	98.495603 min	Anom period:	98.495603 min	Anom period:	119.705141 min	Anom period:	119.705141 min
Apogee:	710.901 km	Apogee:	710.901 km	Apogee:	1700.455 km	Apogee:	1700.455 km
Perigee:	693.854 km	Perigee:	693.854 km	Perigee:	1671.602 km	Perigee:	1671.602 km
Ref perigee:	2831.69369814	Ref perigee:	2831.69369814	Ref perigee:	2830.01975372	Ref perigee:	2830.01975372
Wed Oct 2 16:38:55.519 1985 UTC		Wed Oct 2 16:38:55.519 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC	
Beacon:	145.8260 MHz	Beacon:	145.8260 MHz				

Satellite		OSCAR-9		Satellite		RS-8	
Catalog number	14781	Catalog number	14781	Catalog number	12998	Catalog number	12998
Epoch time:	85275.71454271	Epoch time:	85275.71454271	Epoch time:	85274.03973838	Epoch time:	85274.03973838
Wed Oct 2 17:08:56.490 1985 UTC		Wed Oct 2 17:08:56.490 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC	
Element set:	89	Element set:	89	Element set:	341	Element set:	341
Inclination:	98.1810 deg	Inclination:	98.1810 deg	Inclination:	82.9531 deg	Inclination:	82.9531 deg
RA of node:	340.8135 deg	RA of node:	340.8135 deg	RA of node:	250.3508 deg	RA of node:	250.3508 deg
Eccentricity:	0.0012070	Eccentricity:	0.0012070	Eccentricity:	0.0017936	Eccentricity:	0.0017936
Arg of perigee:	250.2792 deg	Arg of perigee:	250.2792 deg	Arg of perigee:	273.3515 deg	Arg of perigee:	273.3515 deg
Mean anomaly:	109.7087 deg	Mean anomaly:	109.7087 deg	Mean anomaly:	86.5464 deg	Mean anomaly:	86.5464 deg
Mean motion:	14.61994195 rev/day	Mean motion:	14.61994195 rev/day	Mean motion:	12.02955854 rev/day	Mean motion:	12.02955854 rev/day
Decay rate:	8e-07 rev/day²	Decay rate:	8e-07 rev/day²	Decay rate:	4e-08 rev/day²	Decay rate:	4e-08 rev/day²
Epoch rev:	8474	Epoch rev:	8474	Epoch rev:	16636	Epoch rev:	16636
Semi major axis	7061.956 km	Semi major axis	7061.956 km	Semi major axis	8043.182 km	Semi major axis	8043.182 km
Anom period:	98.495603 min	Anom period:	98.495603 min	Anom period:	119.705141 min	Anom period:	119.705141 min
Apogee:	710.901 km	Apogee:	710.901 km	Apogee:	1700.455 km	Apogee:	1700.455 km
Perigee:	693.854 km	Perigee:	693.854 km	Perigee:	1671.602 km	Perigee:	1671.602 km
Ref perigee:	2831.69369814	Ref perigee:	2831.69369814	Ref perigee:	2830.01975372	Ref perigee:	2830.01975372
Wed Oct 2 16:38:55.519 1985 UTC		Wed Oct 2 16:38:55.519 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC	
Beacon:	145.8260 MHz	Beacon:	145.8260 MHz				

Satellite		OSCAR-9		Satellite		RS-8	
Catalog number	14781	Catalog number	14781	Catalog number	12998	Catalog number	12998
Epoch time:	85275.71454271	Epoch time:	85275.71454271	Epoch time:	85274.03973838	Epoch time:	85274.03973838
Wed Oct 2 17:08:56.490 1985 UTC		Wed Oct 2 17:08:56.490 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC	
Element set:	89	Element set:	89	Element set:	341	Element set:	341
Inclination:	98.1810 deg	Inclination:	98.1810 deg	Inclination:	82.9531 deg	Inclination:	82.9531 deg
RA of node:	340.8135 deg	RA of node:	340.8135 deg	RA of node:	250.3508 deg	RA of node:	250.3508 deg
Eccentricity:	0.0012070	Eccentricity:	0.0012070	Eccentricity:	0.0017936	Eccentricity:	0.0017936
Arg of perigee:	250.2792 deg	Arg of perigee:	250.2792 deg	Arg of perigee:	273.3515 deg	Arg of perigee:	273.3515 deg
Mean anomaly:	109.7087 deg	Mean anomaly:	109.7087 deg	Mean anomaly:	86.5464 deg	Mean anomaly:	86.5464 deg
Mean motion:	14.61994195 rev/day	Mean motion:	14.61994195 rev/day	Mean motion:	12.02955854 rev/day	Mean motion:	12.02955854 rev/day
Decay rate:	8e-07 rev/day²	Decay rate:	8e-07 rev/day²	Decay rate:	4e-08 rev/day²	Decay rate:	4e-08 rev/day²
Epoch rev:	8474	Epoch rev:	8474	Epoch rev:	16636	Epoch rev:	16636
Semi major axis	7061.956 km	Semi major axis	7061.956 km	Semi major axis	8043.182 km	Semi major axis	8043.182 km
Anom period:	98.495603 min	Anom period:	98.495603 min	Anom period:	119.705141 min	Anom period:	119.705141 min
Apogee:	710.901 km	Apogee:	710.901 km	Apogee:	1700.455 km	Apogee:	1700.455 km
Perigee:	693.854 km	Perigee:	693.854 km	Perigee:	1671.602 km	Perigee:	1671.602 km
Ref perigee:	2831.69369814	Ref perigee:	2831.69369814	Ref perigee:	2830.01975372	Ref perigee:	2830.01975372
Wed Oct 2 16:38:55.519 1985 UTC		Wed Oct 2 16:38:55.519 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC	
Beacon:	145.8260 MHz	Beacon:	145.8260 MHz				

Satellite		OSCAR-9		Satellite		RS-8	
Catalog number	14781	Catalog number	14781	Catalog number	12998	Catalog number	12998
Epoch time:	85275.71454271	Epoch time:	85275.71454271	Epoch time:	85274.03973838	Epoch time:	85274.03973838
Wed Oct 2 17:08:56.490 1985 UTC		Wed Oct 2 17:08:56.490 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC		Tue Oct 1 00:57:13.396 1985 UTC	
Element set:	89	Element set:	89	Element set:	341	Element set:	341
Inclination:	98.1810 deg	Inclination:	98.1810 deg	Inclination:	82.9531 deg	Inclination:	82.9531 deg
RA of node:	340.8135 deg	RA of node:	340.8135 deg	RA of node:	250.3508 deg	RA of node:	250.3508 deg
Eccentricity:	0.0012070	Eccentricity:	0.0012070	Eccentricity:	0.0017936	Eccentricity:	0.0017936
Arg of perigee:	250.2792 deg	Arg of perigee:	250.2792 deg	Arg of perigee:	273.3515 deg	Arg of perigee:	273.3515 deg
Mean anomaly:	109.7087 deg	Mean anomaly:	109.7087 deg	Mean anomaly:	86.5464 deg	Mean anomaly:	86.5464 deg
Mean motion:	14.61994195 rev/day	Mean motion:	14.61994195 rev/day	Mean motion:	12.02955854 rev/day	Mean motion:	12.02955854 rev/day
Decay rate:	8e-07 rev/day²	Decay rate:	8e-07 rev/day²	Decay rate:	4e-08 rev/day²	Decay rate:	4e-08 rev/day²
Epoch rev:	8474	Epoch rev:	8474	Epoch rev:	16636	Epoch rev:	16636
Semi major axis	7061.956 km	Semi major axis	7061.956 km	Semi major axis	8043.182 km	Semi major axis	8043.182 km
Anom period:	98.495603 min	Anom period:	98.495603 min	Anom period:	119.705141 min	Anom period:	119.705141 min
Apogee:	710.901 km	Apogee:	710.901 km	Apogee:	1700.455 km	Apogee:	1700.455 km
Perigee:	693.854 km	Perigee:	693.854 km	Perigee:	1671.602 km	Perigee:	1671.602 km
Ref perigee:	2831.69369814	Ref perigee:	2831.69369814	Ref perigee:	2830.01975372	Ref perigee:	2830.01975372
Wed Oct 2 16:38:55.519 1985 UTC		Wed Oct 2 16:38:55.519 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC		Tue Oct 1 00:28:26.721 1985 UTC	
Beacon:	145.8260 MHz	Beacon:	145.8260 MHz				

Satellite		OSCAR-9		Satellite		RS-8	
Catalog number	14781</						

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